EUROPEAN REPORT ON DEVELOPMENT

OIL PALM EXPANSION IN RIAU PROVINCE, INDONESIA: SERVING PEOPLE, PLANET, PROFIT ?

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MOBILISING EUROPEAN RESEARCH FOR DEVELOPMENT POLICIES

SYNOPSIS

This paper analyses the relation between the increase of global demand for biofuels and rapid oil palm expansion in Riau, Indonesia and in particular how these lead to more intensified forest conversion and put food and water security at risk.

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This paper served as a background paper to the European Report on Development 2011/2012: *Confronting scarcity: Managing water, energy and land for inclusive and sustainable growth*. The European Report on Development was prepared by the Overseas Development Institute (ODI) in partnership with the Deutsches Institut für Entwicklungspolitik (DIE) and the European Centre for Development Policy Management (ECDPM).

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Abbreviations

BAU	Business as usual
CO_2	Carbon dioxide
CPO	crude palm oil
DO	Delivery order
ETS	Emission Trading Scheme
EU	European Union
FAO	Food and Agricultural Organization
FWI	Forest Watch Indonesia
GDP	Gross domestic product
GHG	Greenhouse gas
GIS	Geographical Information Systems
GTAP	Global Trade Analysis Project
ha	Hectare
IATA	International Air Transport Association
IDR	Indonesian Rupiah
IEA	International Energy Agency
ILUC	Indirect land use change
IRRI	International Rice Research Institute
MT	Million Tons
MWe	Megawatt electrical
NGO	Non-governmental organisation
REDD+	Reduce emissions from deforestation and degradation
RSPO	Roundtable on Sustainable Palm Oil
US	United States of America
USDA	U.S. Department of Agriculture
WESP	UN World Economic Situation and Prospects
WWF	World Wildlife Fund

1 Introduction

While fuel consumption is increasing worldwide, especially in the transport sector, the supply of fossil fuels which are easily extractible at affordable prices is depleting. This development and the urgency of the need to reduce global greenhouse gas (GHG) emissions, especially in the road transport sector and recently in the aviation sector as well, has triggered demand for alternative fuels, most notably biofuels. Although most commonly used in the food processing industry, the tropical oil palm is nowadays viewed also as one of the most promising biofuel crops, having one of the highest yields of all suitable biofuel crops.

Indonesia is the world's main producer of palm oil. It is the country's largest export product after oil and natural gas, accounting for one-tenth of foreign exchange receipts, and 85% of palm oil is exported (Fischer, 2010). Palm oil is also an important commodity within Indonesia. It contributes substantially to regional incomes, and in some regions is the major driver of economic development. As most plantations are in rural areas, employment for the rural population can be significant. For instance, in 2010, over 40% of oil palms were cultivated by 3.5 million smallholders (World Growth, 2011). Finally, palm oil is by far the most important product in food processing, and also the most common cooking oil in Indonesia: its relatively low price makes it affordable for all Indonesians.

Given growing worldwide demand for palm oil for both food and fuel, the availability of land for conversion to oil palm estates may pose a significant challenge to the growth of the Indonesian palm oil industry (World Growth, 2011). The effects of this growing pressure on land use, known as processes of indirect land use change (ILUC), are increasingly being analysed. In many cases, studies focus on the fact that oil palm expansion has involved large-scale forest conversion. Yet there are wider, less visible effects of oil palm expansion at the regional and local level in Indonesia, on land use in general and on the forest in particular. These impacts have seen barely any analysis and are little understood.

This paper therefore aims to enable a better understanding of such broad-based effects of oil palm expansion on local economic development, land use processes and people's livelihoods. Not only do forest conversion processes and biodiversity losses seem to be linked directly to processes of oil palm expansion, but also they are changing the distribution of the population, through either voluntary (in-migration) or involuntary (displacement) ways.

The next section provides a general background of the global debate on the growing demand for palm oil in the food processing industry, and the more recent growing demand for the crop as a biofuel. The subsequent section moves the focus towards Indonesia, explaining how Indonesian policies respond to global palm oil demand. We then focus on Riau province in Sumatra, which was the site of research into the direct and indirect effects of oil palm expansion on forests, the economy and the people. The empirical (results) section showcases the regional and local effects of oil palm expansion in terms of forest conversion and analyses whether oil palm plantations (both large and small scale) allow the population to contribute to and benefit from resource-led economic development. Finally, we discuss the possible future implications of this development in Riau province, in the context of growing demand for the oil palm as a food crop and a biofuel.

Although the results presented here are by no means complete, it is hoped that this analysis will enhance our understanding of the opportunities oil palm expansion provides for a broader-based, more inclusive type of development, one which could generate profit for investors and welfare for the people at the same time as being environmentally sustainable.

2 Energy, biofuels and oil palm development at a global level

The world's energy consumption is steadily increasing, especially in the transport sector (Kojima and Ryan, 2010). So far, fossil fuels (oil, natural gas and coal) have been the main energy sources, accounting for about 80% of the world's energy consumption (World Bank, 2011). However, it is increasingly being recognised that fossil fuel reserves which can be exploited at affordable prices are rapidly being depleted.

This is especially the case with by far the most important fossil fuel: oil. The gap between production and consumption of crude oil has increased steadily in the past three decades, as Figure 2.1 shows, leading to price increases (Roper, 2011). Meanwhile, as the UN World Economic Situation and Prospects (WESP) report (DESA, 2012) clearly shows, political unrest in the Middle East and financial problems in the European Union (EU) have also led prices to fluctuate greatly (Shah, 2011). For instance, by July 2008, the crude oil price had reached $132.55/barrel, the highest price ever, but by December 2008 it had dropped to $41.53/barrel and by April 2011 to $116.32/barrel (Index Mundi, 2011a). March 2012 saw similar prices, ranging between $105 and $124/barrel (Oil-price.net, 2012).

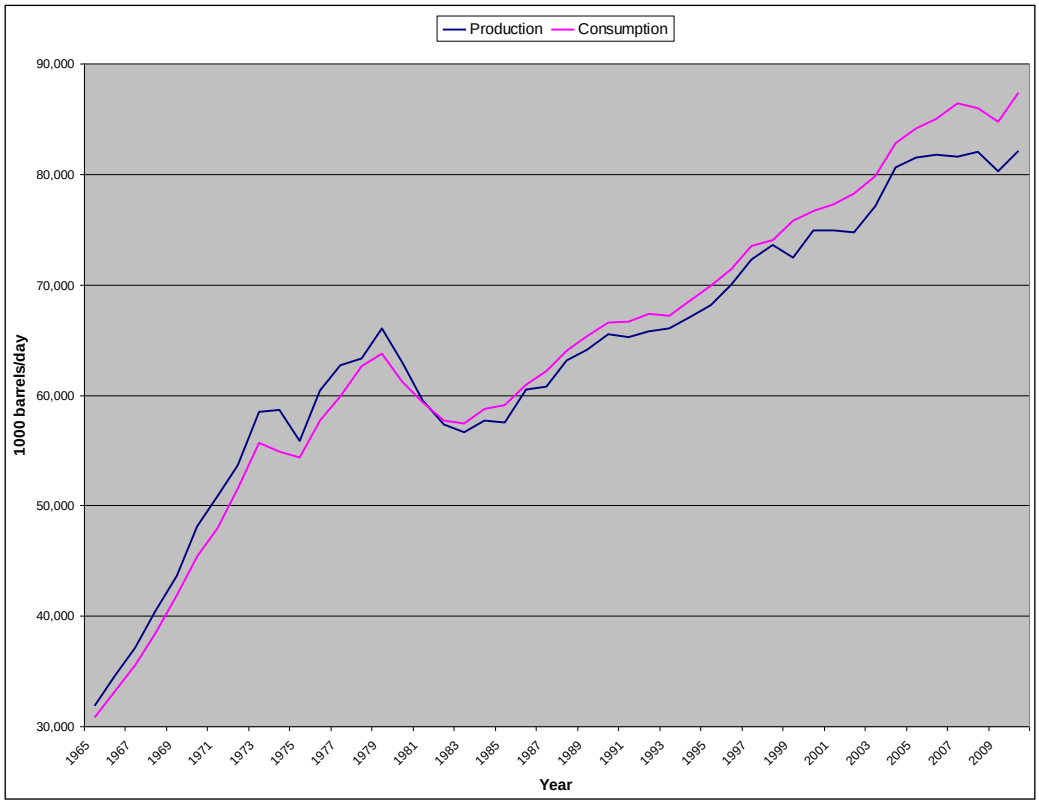
For many countries, such increasing and fluctuating prices become a real burden for the transport and industrial sectors, not least because they make sound annual financial planning increasingly difficult. These developments and the need to comply to reduce global GHGs under the Kyoto Protocol have led to a growing demand for renewable sources of fuel, most notably biofuels. The tropical oil palm (Elaeis guineensis) is viewed as one of the most promising agricultural crops in this regard. Table 2.1 shows that yields from the oil palm (litres oil/ha) are by far the highest of all vegetable oils. In addition, the crop has a wide range of area suitability (Fitzherbert, 2008), with most plantations in Malaysia and Indonesia (Figures 3C and 3D). In Indonesia, the majority of oil palm plantations are to be found on the islands of Sumatra and Kalimantan.

Table 2.1 Vegetable oil yield/ha

Crop	Oil palm	Coconut	Jatropha	Sunflower	Sesame	Soybean	Corn (maize)
Litres oil/ha	5,950	2,689	1,892	952	696	446	172

Source: Journey to Forever (2010)

Figure 2.1 World crude oil production and consumption, 1995-2009



Source: BP (2011)

The need to find alternative fuel sources, such as biofuels, could particularly affect those countries that rely heavily on foreign sources of energy and where the transport sector contributes significantly to national GHG emissions: the US and countries in the EU.

3 EU and US biofuel scenarios

In the EU, the use of biofuels and other renewable fuels for transport has been stimulated since 2003 (European Parliament and EU Council, 2003). Together with the US, the EU has set rather ambitious targets for biofuel use in the transport sector, including a 20% cut in carbon emissions in the next 10 years. The EU also recently set out its aim to ensure biofuels make up 40% of the overall aviation fuel mix by 2050 (Green Air, 2011). Already, the International Air Transport Association (IATA) has set a target to mix 6% biofuels in aviation by 2020 (Manila Bulletin, 2011). Lane (2011) estimates that cutting 20% of road transport emissions would require the use of 1.5 billion tons of biomass. Converting 20% of aviation fuel to biofuels would require roughly an additional 120 million tons of biomass. The EU will further stimulate this, as the aviation sector has been included in the Emission Trading Scheme (ETS) (EC Climate Action, 2012). This means Member State governments set limits, or 'caps', on the total amount of emissions allowed from the aviation sector. Palm oil is viewed as important in this respect: it is estimated that the supply of palm oil will have to double to meet global demand between 2010 and 2020 (Hart Energy, 2011).

This increasing demand for biofuels has led to a new trend in global agrarian political economy, including in terms of investments in land, in particular in the global South (Borras, 2010; Vermeulen and Cotula, 2010). Although figures vary greatly, the International Energy Agency (IEA) in 2006 had already estimated that land requirements for biofuel production under the IEA Alternative Policy scenario would amount to 52.8 million ha in 2030 (IEA, 2006). With the world's population estimated to reach 9 billion in 2050 (FAO, 2010a), competition for the remaining land base is likely to increase. Meanwhile, to feed this growing population, food production is estimated to increase by 70% (FAO, 2011). Although the exact amount of additional land required to meet the demand for food is uncertain, the Food and Agricultural Organization (FAO) estimates it at around 70 million ha in 2050 (FAO, 2010a). Adding to this the 52.8 million ha needed for biofuel production, it is clear that land use in producer countries, including Indonesia, will be affected (IEA, 2006).

Various studies analysing global ILUC processes involved in this growing demand for biofuels confirm this. Edwards et al. (2010) compare various models and results in relation to marginal biofuel production from different feedstock. The estimated total global ILUC ranges from 223 to 743 kHa per Mtoe, and Edwards et al.'s evaluation of all EU biodiesel scenarios shows that the largest share of land use change will occur outside the EU. In the extra palm oil scenarios, the projected ILUC change is between 103 and 425 kHa per Mtoe. In one of the models, the LEITAP model, all ILUC would occur in Indonesia; in the GTAP model, the largest share would occur outside the Malaysia/Indonesia region. Meanwhile, Wicke (2011) evaluates a number of prominent academic sources and data from leading international organisations, including FAO, on land conversion processes in Indonesia caused by oil palm expansion. Their study shows that, between 1975 and 2005, 40 million ha of forest were lost in Indonesia alone as a result of oil palm expansion, equal to a 30% reduction in forested land, for both food and biofuel production. Koh and Ghazoul (2010) put the figure as high as 50% forest losses. Since 2006, Indonesia has been the main producer of palm oil and, together with Malaysia, controls over 85% of the world market for palm oil (FAO, 2010a).

4 Energy and biofuels in Indonesia

In Indonesia, about 85% of palm oil is used for food purposes (Goenadi, 2005), an aspect which is viewed as very important in the country in relation to food security. With around 238 million people and population growth of 1.02% per year, maintaining food security at affordable prices is crucial to national security (Timmer, 2004). However, now that biofuels are becoming more important, oil palm is increasingly being valued for this purpose, and growing demand has increased export prices enormously. To ensure the food aspect of palm oil and reduce volatility in cooking oil prices, the government reviews export prices monthly. It imposes a 1.5% duty on overseas shipments of crude palm oil if the average price reaches at least $700 per ton and a 3% tax if it ranges between $751 and $800. The tax can rise to a maximum of 25% if the price reaches $1,250 per ton (Jakarta Globe, 2009).

However, Indonesia has also signed commitments to reduce national GHG emissions, recently even stating that it will reduce these by 26% in 2020 from the business as usual (BAU) scenario (Forest Climate Center, 2009). Under the assumption of annual population growth of 1.02% per year and gross domestic product (GDP) between 5.5% and 7.2%, the annual growth of final energy consumption is projected to be 6.7% per year under a BAU scenario (IEA, 2008). In this context, CO2 emissions per capita increased from only 0.3 MT in 1970 to 1.73 MT in 2008 (World Bank, 2012). In the energy conservation scenario, the growth of final energy consumption is estimated to be lower, at 5.7 % annually (IEA, 2008).

The government of Indonesia has also set targets to secure national energy supplies, for both electrification as well as the transport sector. To meet the targets of electrification (Indonesia lags behind most other countries in the East Asia and Pacific region on electrification, at 57%) and the reduction of GHG emissions, Indonesia can potentially generate 1,160 MWe by using biomass. Supplies of biomass come from plywood mills, sawmills, sugar mills, rice mills and palm oil mills. Biomass supply from sugar and rice mills is dominant in Java, as the island is a major rice and sugarcane planting area. Sumatra sources 69% of its biomass supply from rice and palm oil mills. Kalimantan is well known for its large forestry resources, able to procure 89% of its biomass supply from saw and plywood mills (World Bank Indonesia, 2005). It is expected that, by 2025, Indonesia's energy mix will be composed of 30% natural gas, 20% oil, 33% coal and 17% renewable energy. Renewable energy should consists of 5% geothermal energy, 5% biofuels, 2% coal liquefaction and 5% biomass, nuclear, hydro, solar and wind (Kementrian Energi dan Sumber Daya Mineral, 2006).

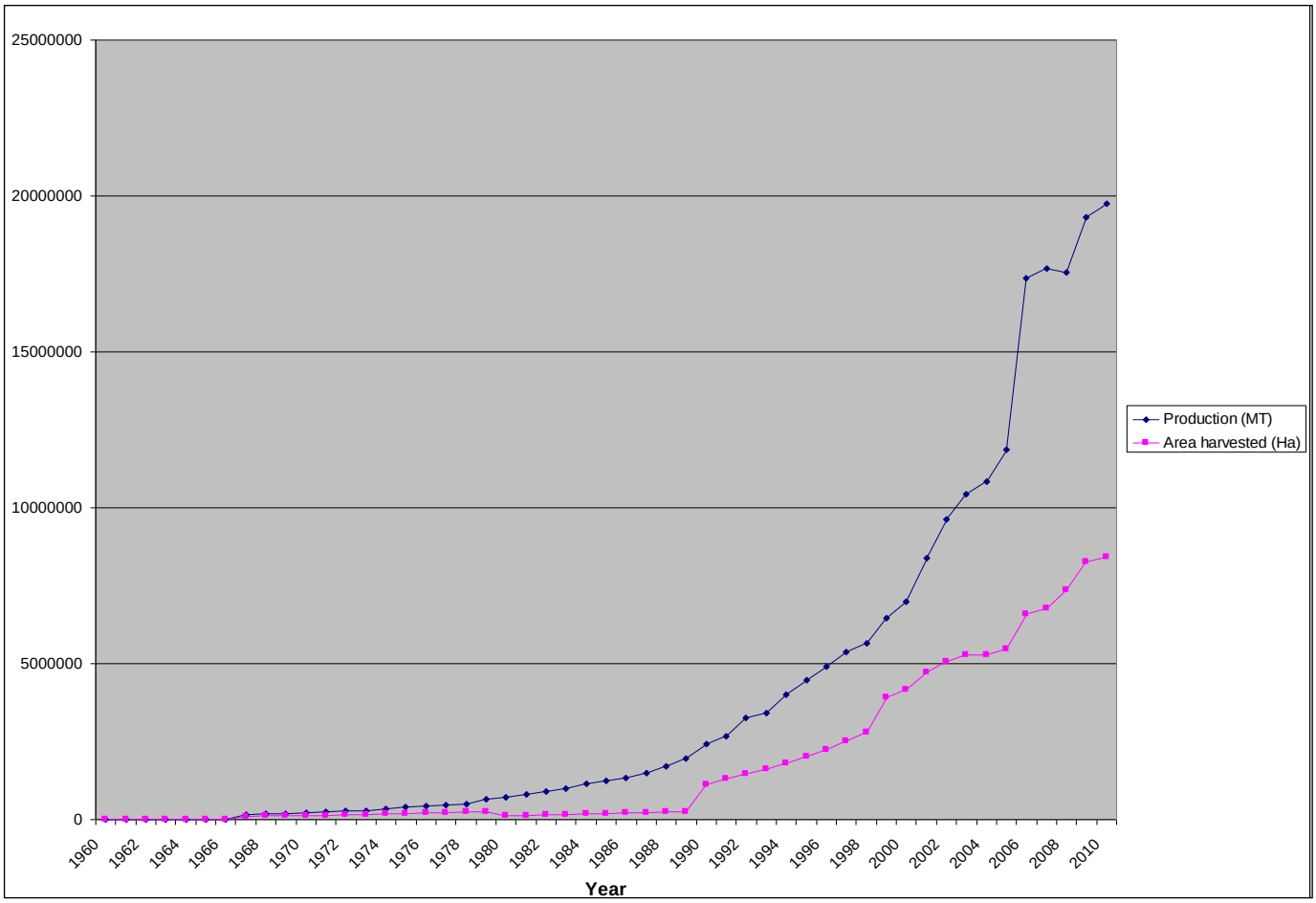
Biofuels have been identified as the primary energy resource to diversify transport fuels to reduce GHG emissions (Wirawan, 2010). The assumption that palm oil is an alternative low carbon option to fossil fuels has made the oil palm an even more important engine of growth. For these reasons, the government of Indonesia allocated 5.25 million ha in 2010 and has committed to allocating an additional 7 million ha by 2025 to oil palm, jatropha, sugarcane and cassava plantations. The investments required for on- and off-farm biofuel development are estimated at around IDR (Indonesian Rupiah) 507 billion or around €42 million. This is expected to create 3.5 million new jobs on plantations, mainly for unskilled, rural labour (IEA, 2008). Meanwhile, the average production costs of oil palm are lower than for any other major biofuel crop (Carter et al., 2007).

Production of national biofuels was as high as 455 million litres in 2010, and it is estimated that it will increase to 650 million litres by 2011 (USDA Foreign Agriculture Service, 2011a). In such a scenario, whereby global, national and local economic development processes and the move towards a low carbon economy seem to support oil palm cultivation, for both food and fuel, oil palm has become one of the world's most rapidly expanding perennial crops (Fitzherbert, 2008).

4.1 Oil palm development in Indonesia

Oil palm emerged as one of the most important cash crops in the mid-1970s, but took off in the late 1990s, partly a result of global demand for healthier fats and more recently because of its increased value as a biofuel. In 2010, Indonesia had around 8.4 million ha producing around 19.8 million MT of palm oil (Figure 4.1 shows the increase in the total area harvested and total production of oil palm). The government of Indonesia plans to expand oil palm production to cover a further 20 million ha by 2020, mainly in Sumatra, Kalimantan, Sulawesi and West Papua (Colchester, 2006).

Figure 4.1 Oil palm harvested area (ha) and production (MT), 1960-2010



Source: Directorate General Estate Crop, Ministry of Agriculture (2010).

Palm oil production is making an increasing contribution to Indonesia's national income, especially through the export of crude palm oil (CPO) and its derivatives (Badan Pusat Statistik, 2011c). The major export destinations for palm oil are China, the Netherlands and India. By 2009, Indonesia had exported around 16.9 million MT, valued at around $1.036 billion (FAO, 2010b). In 2012, it is predicted that total production of palm oil will be at 25.4 million MT, with exports at 19.35 million MT and total domestic consumption at around 6.04 million MT, including 1.25 million MT for biofuels and the oleo-chemical industry (USDA Foreign Agriculture Service, 2011b).

To benefit more from palm oil earnings, the Indonesian government is also focusing on the related palm oil industry. One policy measure is to increase the added value of palm oil to serve the global market. Instead of exporting CPO, the government promotes the advanced processing of CPO to produce higher-value downstream derivative products. Three provinces have been targeted to become oleo-chemical industrial clusters: North Sumatra, Riau and East

Kalimantan (Antara News, 2010). This shows that palm oil has the potential to contribute to broad-based economic development. It also generates significant employment: in 2006, it was estimated that about 1.7-2 million people worked in the palm oil industry (World Growth, 2011), most of them in rural areas. Although these benefits can represent an engine of growth, their sustainability from an environmental point of view are highly debated, as the process is assumed to cause large-scale land use change processes.

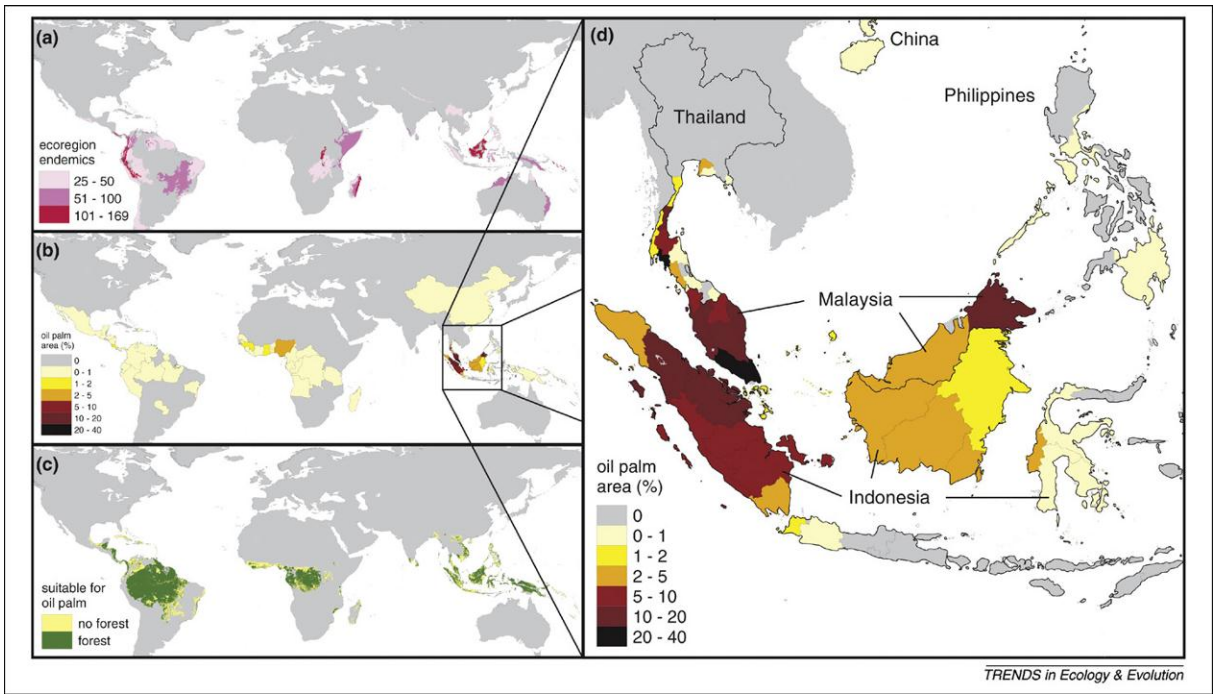
4.2 Oil palm and land use change in Indonesia

Several studies on the direct and indirect effects of using palm oil both for food and as a biofuel show that the establishment of oil palm plantations involves forest clearing. Figure 4.2 shows that the future expansion of oil palm plantations assumes further forest conversion, which could lead to serious biodiversity decline and large increases in GHG emissions, since the areas suitable for oil palm mostly overlap with the frontier for the world's most significant biodiversity areas (Fitzherbert, 2008). If the effects of land use change through forest conversion are taken into consideration, biofuel production appears to be more negative in relation to GHG emissions and biodiversity losses than the use of fossil fuels (Koh, 2007; Koh and Wilcove, 2008).

Depending on the forest type, the time required to recapture the released carbon for the establishment of oil palm plantations through land use change varies significantly. Studies in East Kalimantan show that tropical natural forests are among the greatest reservoirs for biomass and serve as huge carbon sinks (Basuki et al., 2009; Danielsen et al., 2009; Hashimoto et al., 2000; Tangki et al., 2008). Conversion of these kinds of forests to other land uses will diminish most of the above-ground biomass per ha and release huge amounts of carbon. The payback time for the loss in carbon involved in establishing oil palm plantations on degraded grassland is 10 years; for rainforests cleared by fire (the most common and cheapest option) is around 93 years and as high as 692 years for converted peat swamp forests (Block, 2009). GHG emissions are estimated to be huge when oil palm plantations are established on previous peatland forests, given peat decomposition and peat fire (Uryu et al., 2008). One study on tropical peatlands conversion into acacia and oil palm plantations in South East Asia shows that the average carbon emission rate is around 100 ton/ha/year CO2eq (Hooijer et al., 2011). It is also suggested that water management contributes only 20% to carbon conservation and high carbon emissions should be accepted as inevitable consequences of tropical peatland conversion (ibid.).

Despite the relatively fast payback time in grassland areas, these are not favoured for oil palm investments, even though the soil in grassland areas is not necessary infertile (Friday et.al., 1999). The main reason for avoiding such areas is that, prior to land preparation, substantial short-term earnings can be obtained through timber harvesting from clear-cutting the forest. This additional income remains a major driver for converting forests (Hunt, 2010).

Figure 4.2 Distribution of current oil palm plantations and biodiversity rich areas in Indonesia



Source: Fitzherbert (2008).

As Indonesia's deforestation rates are high, under pressure from international non-governmental organisations (NGOs) and the Norwegian government the government of Indonesia recently issued a regulation on a moratorium on natural forest and peatland conversion, including forest conversion into oil palm plantation, as part of a broader $1 billion Indonesia-Norway partnership to reduce emissions from deforestation and degradation (REDD+) (Murdiyarso et al., 2011).

Although oil palm expansion has been studied for its negative environmental consequences, a number of analyses find these discussions rather exaggerated. In Indonesia, the area under oil palm increased by 4.4 million ha to 6.1 million ha between 1990 and 2005, while the total loss of tropical forest was 28.1 million ha (Koh and Wilcove, 2008). Hence, conversion of rainforest to oil palm plantations could account for at most 16% of recent deforestation (Fitzherbert, 2008), and this only if all oil palm has been planted on former forestland, which is not always the case. A study on the impact of oil palm plantations on forests in Malaysia and Indonesia reveals that oil palm plantations have made a limited contribution to total forest loss (Butler, 2011). More precisely, it is estimated that only 1.7-3.0 million ha of forest have been lost to oil palm plantations over the past 20 years (Koh and Wilcove, 2008), so forest loss to palm oil accounts for about 3.9% to 10.5% of total deforestation in Indonesia.

Box 4.1 The Indonesian forest moratorium

In 2009, the President of Indonesia announced a 26% carbon emission reduction by 2020 (Forest Climate Center, 2009). One year later, the Indonesian and Norwegian government signed a letter of intent on reducing GHG emissions through avoiding deforestation and forest degradation, also known as REDD+ (as part of the Bali Action Plan). The letter of intent is supported by a $1 billion grant from the Norwegian government. Several actions have been agreed, including a two-year suspension of all new concessions for the conversion of peat and natural forest (Royal Norwegian Embassy Jakarta, 2010).

In May 2011, the Indonesian government issued Presidential Instruction 10/2011 on the suspension of new concessions and the improvement of primary natural forest and peatland governance. This aims to balance economic, social and cultural development and the environment and reduce GHG emissions by bringing down emissions from deforestation and forest degradation. It exempts already existing licenses and those that obtained principle approval before the moratorium was enacted; also excluded are those vital to national development (geothermal, oil and natural gas, electricity, land for rice field and sugarcane plantations) and ecosystem restoration, as is the extension of existing forest utilisation and/or forest area utilisation licenses as long as the license of the business is still valid. Areas under moratorium are shown on a moratorium map to be updated every six months (Ministry of Forestry, 2011).

Many stakeholders have contested this regulation. Business and bureaucrats are worried about the impacts of the moratorium on economic growth (Skalanews, 2011). Environmental groups feel there are too many exceptions in the regulation and land use plans and forest governance are weak (Green Radio, 2011). However, researchers see the regulation as a step forward in terms of good forest governance in that it suggests transparency among relevant ministries and agencies and dialogue with the public to improve the indicative moratorium map (Murdiyarso et al., 2011).

Pehnelt and Vietze (2010) further argue that, since 2000, other land use, such as buildings and roads, has increased by 9.4 million ha, compared with oil palm plantings of about 2.9 million ha, a higher loss in relation to forestry land. Global Forest Watch (2012) estimates that nearly 7 million ha of forest had been approved for conversion to estate crop plantations by the end of 1997 and this land has almost certainly been cleared. But the area actually converted to oil palm plantations since 1985 is about 2.6 million ha, whereas new plantations of other estate crops probably account for another 1-1.5 million ha. The implication is that 3 million ha of former forestland are lying idle, supposed to be planted with oil palms. It remains unclear whether studies have incorporated these kinds of conversion processes.

Calculating forest losses at national level might also provide a skewed picture in terms of the extent to which oil palm contributes to forest loss. Large-scale building activities take place mainly on the island of Java, where relatively little forest is left and hardly any oil palm plantations are found. In addition, there is quite a difference between land classified as forestry land and actual forest cover. Conversion of forestry land does not necessarily mean there was forest cover on these lands: in many cases the land is covered with imperata grasslands (Budidarsono and Burgers, 2005; Fox, 2000). Hence, it cannot automatically be assumed that conversion of forestry land comes at the expense of forests. Oil palm cultivation takes place mainly on three islands, known for their vast forest cover: Sumatra, Kalimantan and, recently, West Papua. Studies showing high deforestation figures focus on these islands (FWI and Global Forest Watch, 2001) and, as explained before, oil palm expansion on forestland is favoured because of the opportunity this presents to earn money from the sale of the timber. It is therefore important to analyse real forest cover losses using remote sensing pictures and ground-level evidence.

Our study focuses on the main palm oil producing island, Sumatra, and in particular on the most important oil palm province, Riau. Oil palm plantation started in Riau a long time ago, and the province has been classified as an oleo-chemical cluster, meaning palm oil is viewed as

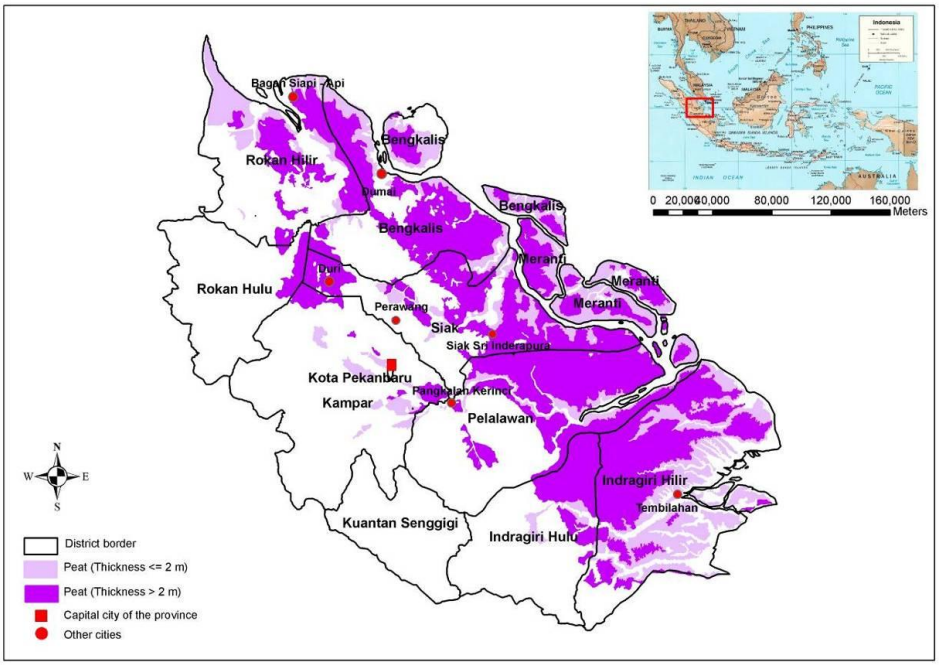
an important engine of growth for (economic) development. It therefore provides a good opportunity to study ways in which oil palm plantations can promote economic development and the extent to which oil palm expansion has led to land use change processes at the expense of forest cover.

4.3 Riau Province: general characteristics

Riau province is situated in the middle of the island of Sumatra and has a total area of 8.9 million ha. It has a population of around 4.7 million with a population density of 50 per km2. Around 49.3% of the labour force works in the agriculture sector. This includes cash crop cultivation, estate crops, livestock production, fisheries and forestry, both on a large scale and in small-scale enterprises (Badan Pusat Statistik Propinsi Riau, 2010).

Riau province is blessed with a wide variety of abundant natural resources, the main ones being oil, natural gas and gold as well as huge forest reserves (timber), wildlife and fish. The province's economy is therefore resource-led. Fossil fuel exploitation started in the beginning of the 19th century (Uryu et al., 2008) and has been Riau's main income source, contributing up to 40% of GDP (Badan Pusat Statistik Propinsi Riau, 2011). Until the 1960s, Riau still had extensive forest areas. The province has both natural and plantation forests (Ministry of Forestry, 1986), as well as several national parks (ibid., 2005) and extensive and deep contiguous tropical peat swamp forests distributed over several districts (Center for Soil and Agroclimate Research, 1990). Figure 4.3 shows the study area and the distribution of peatlands within it.

Figure 4.3 Administrative and soil type maps of Riau province



Source: Center for Soil and Agroclimate Research (2011).

Large-scale timber harvesting from natural forest through forest concession licensing started with the issuing of Basic Law 5/1967 on Forestry. This was followed by the establishment of pulp and paper industries in the early 1980s. The development of these industries was supported by the conversion of natural forest into industrial tree plantations. Huge investments in roads for the transportation of logs to processing facilities along the coast enabled the industry to grow. In 2008, the industrial forest plantation area was estimated to occupy around 1.6 million ha (Balai Pemantauan Pemanfaatan Hutan Produksi Wilayah III Pekanbaru, 2008).

Table 4.1 GDP of Riau based on sources of origin, 2005-2009 (%)

	Source of GDP	2005	2006	2007	2008	2009
1	Agriculture	21.7	21.7	20.8	19.2	19.0
2	Mining and quarrying	41.7	42.2	43.4	44.8	42.0
3	Manufacturing industry	20.1	19.3	18.6	18.2	19.3
4	Electricity, water supply and gas	0.2	0.2	0.2	0.2	0.2
5	Building and construction	2.5	2.5	3.4	4.1	4.6
6	Trade, restaurants and hotels	6.6	6.7	6.7	7.0	7.8
7	Transportation and communication	1.9	1.9	1.8	1.8	1.8
8	Finance and insurance	1.8	1.9	1.9	1.8	2.1
9	Services	3.5	3.5	3.3	3.0	3.2
	Total	100.0	100.0	100.0	100.0	100.0

Source: Badan Pusat Statistik Propinsi Riau (2011).

In spite of the rapid development of oil palm plantation, mining and quarrying still represent the main sources of GDP for Riau province (see Table 4.1). The agriculture sector contributes around 19% of total GDP (Badan Pusat Statistik Propinsi Riau, 2011). Within agriculture, the estate crop sub-sector is the largest contributor (up to 50%), as Table 4.2 shows.

Table 4.2 Contribution of the estate crop sub-sector to total GDP in Riau, 2004-2009 (%)

Year	2004	2005	2006	2007	2008	2009
Estate crop to agriculture	46.9	49.5	50.9	51.1	50.6	47.9
Estate crop to total GDP	9.7	10.7	11.1	10.6	9.7	9.1
Agriculture to total GDP	20.7	21.7	21.7	20.8	19.2	19.0

Source: Dinas Perkebunan Provinsi Riau (2010); authors' calculation.

However, in terms of employment, agriculture is the most important sector in Riau. In 2009, it created more than 48% of employment in the province, significantly higher than the national figure, as Table 4.3 shows.

Table 4.3 Employment based on types of activity, national and provincial (%)

	Type of activity	National	Riau province
1	Agriculture	39.7	48.4
2	Mining and quarrying	1.1	2.1
3	Manufacturing industry	12.2	5.8
4	Electricity, water supply and gas	0.2	0.5
5	Building and construction	5.2	4.8
6	Trade, restaurants and hotels	20.9	18.2
7	Transportation and communication	5.8	4.8
8	Finance and insurance	1.4	1.5
9	Services	13.4	13.9
	Total	100.0	100.0

Source: Badan Pusat Statistik Propinsi Riau (2011); Badan Pusat Statistik (2011a).

The local population alone cannot meet these employment levels. For a long time, transmigration programmes have enabled the settling of large groups of mainly Javanese people in Riau to work in the tree plantation sector and on other plantations, and more recently to serve the oil palm sector. Over the years, these settlements have grown and developed into what are now relatively large towns, for example Tualang district (Perawang town) and Pangkalan Kerinci district (Pangkalan Kerinci town), whose inhabitants are 93,118

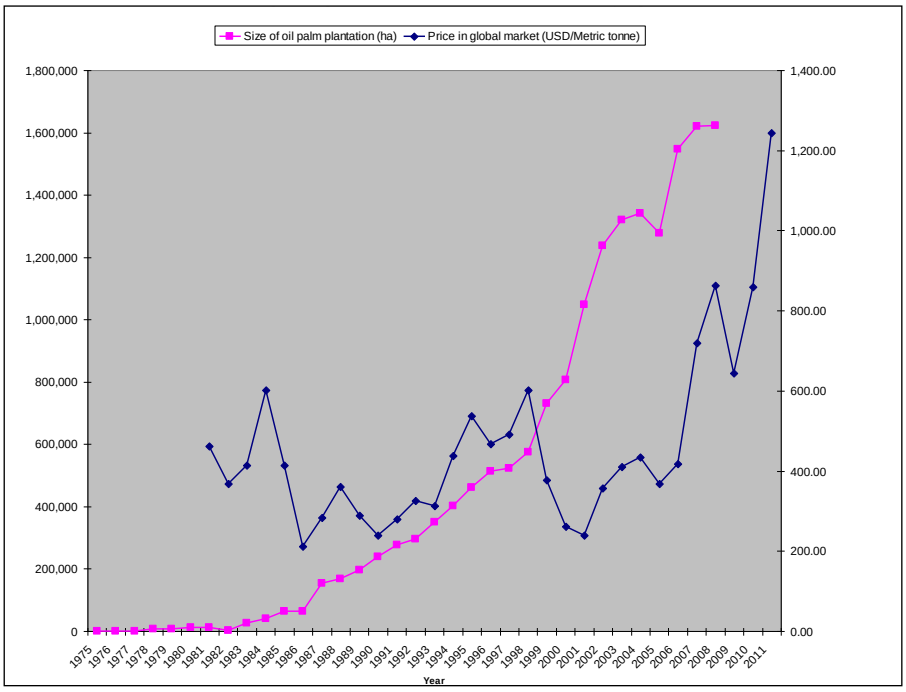
(271 inhabitants/km2) and 71,219 (370 inhabitants/km2), respectively. Both towns started as tree plantation settlement (Badan Pusat Statistik Propinsi Riau, 2011).

Where tree plantation development has remained a large-scale activity, mainly because smallholders can harvest the timber only once and only after five to eight years, smallholder involvement in large-scale agricultural activities has changed completely as a result of the spread of oil palm plantation in Riau.

4.4 Oil palm plantation in Riau Province

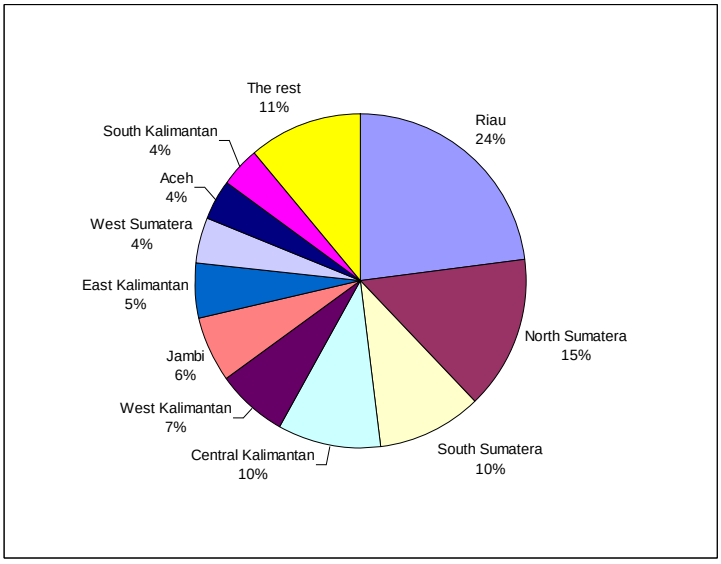
The rapid development of oil palm plantation in Riau has led the province to be the largest producer of palm oil in Indonesia, with the greatest area harvested in the country. Palm oil production in Riau contributes up to 24% of total national production, as Figure 4.4 shows. Nowadays, registered oil palm plantations (including state-owned, smallholder and private enterprises) take up about 1.9 million ha of land, or around 21% of the total area of Riau province (Dinas Perkebunan Provinsi Riau, 2010). From 2004 to 2009, the oil palm area increased by 21%, most probably as a result of the growth of smallholder plantations (Directorate General Estate Crop, Ministry of Agriculture, 2010). Smallholder plantations involve around 380,000 families, producing around 5.9 million tons of fresh bunch fruit annually on around 1 million ha. These are processed in 144 palm oil mills in the province (Dinas Perkebunan Provinsi Riau, 2010).

Figure 4.4 Development of oil palm plantations in Riau province in relation to the global palm oil price



Source: Directorate General Estate Crop, Ministry of Agriculture (2010); Index Mundi (2011).

Figure 4.5 Distribution of major oil palm plantations by province in ha (%)



Source: Directorate General Estate Crop, Ministry of Agriculture (2010).

At the start, smallholders consisted mainly of so-called 'supported smallholders'; after 1995, independent smallholders started to work in oil palm development in the province. Supported smallholders cultivate oil palms with direct support from either the government or the private sector and as part of a large-scale plantation with a processing mill. Both government and the private sector provide technical assistance and inputs, including fertilisers and pesticides, but all on a loan basis. The newer smallholders are more independent in terms of initial capital for estate development.

Table 4.5 Types of oil palm plantation and their area

Type of plantation	Area		Production of fresh fruit	
	Ha	%	Ton	%
State-owned estates	79,545	4	337,727	6
Private estates	849,597	44	2,936,537	50
Smallholder plantations	996,199	52	2,658,044	45
Total	1,925,341	100	5,932,308	100

Source: Dinas Perkebunan Provinsi Riau (2010)

Government Regulation 13/1995, which allowed investors to establish processing industries (oil palm mills) without managing an oil palm plantation, triggered the increase in the number of independent and spontaneous smallholders. This is because, in the absence of a plantation, oil palm mills needed to buy their raw materials from individual (small-scale) producers. Oil palm became mainly an independent smallholder crop, with growers cultivating it without direct assistance from the government or private companies. Instead, middlemen play an important role in financing the development of the crop, especially in the absence of access to bank loans. Middlemen are also an important link between the palm oil mills and small-scale producers, as the latter cannot deliver their products directly to the processing mill given transport constraints. This so-called delivery order (DO) system is based on DO contracts of fresh bunch oil palm (Box 4.2).

Box 4.2 The DO system

The DO system is the purchasing system for raw materials used by oil palm processing units (oil palm mills). It is based on a contract made between the mill and the raw material supplier (the fresh bunch fruit supplier), which states the amount of raw materials that will be delivered by the supplier to the mill in a year. The amount of fresh bunch fruit deliveries can vary from one supplier to another. Suppliers have to pay a deposit to the mills, which is estimated as the total value of fresh bunch fruit they should deliver. For this reason, most individual small-scale producers (farmers) are not able to access the DO directly from the mill.

Therefore, DO holders are mostly those who have sufficient money to pay the deposit and the transportation means to deliver the fresh bunch fruit to the mills. These middlemen connect the small-scale farmers and the oil palm mills. They send their trucks to the farms and buy the fruit directly from the farmers. Depending on the harvest, a truck can go to several farms to fulfil its transporting capacity. It then goes to the mill to deliver the raw material, then paying the farmers using the deposit money.

In theory, farmers are free to choose their middlemen because there is normally no contract between the middlemen and farmers. This makes the price of the fresh bunch fruit on the local market quite competitive. In practice, however, the majority of small-scale producers must sell their fruit to the middleman to whom they are bound because of loans they receive from them to invest in the establishment of the plantation.

Oil palm is becoming the major crop in Riau, creating an increasing number of jobs. Table 4.6 shows that, while the number of people working in other types of crops is decreasing, oil palm cultivation continues to increase.

Table 4.6 Employment share in the estate crop sub-sector

	Types of crop	2009	2010	% difference
1	Oil palm	602,478	693,123	15.0
2	Coconut	221,462	211,039	-4.7
3	Rubber	200,888	196,260	-2.3
4	Mix crop	121,028	114,163	-5.7
	Total	1,145,856	1,214,585	6.0

Source: Dinas Perkebunan Provinsi Riau (2010; 2011); authors' calculation.

4.5 Methods

This research combines biophysical and social science components. Biophysical data were collected from the field in February-April 2009 and November 2010-February 2011, with 499 points visited to check actual land use to support the land use/coverage classification. Longitudinal spatial data (remotely sensed and GIS data) were collected from relevant offices and websites; ArcGIS Version 9.3.1 was used to analyse these. A combination of remote sensing (Landsat TM), GIS and field was used to create the land use/coverage map for 2010.

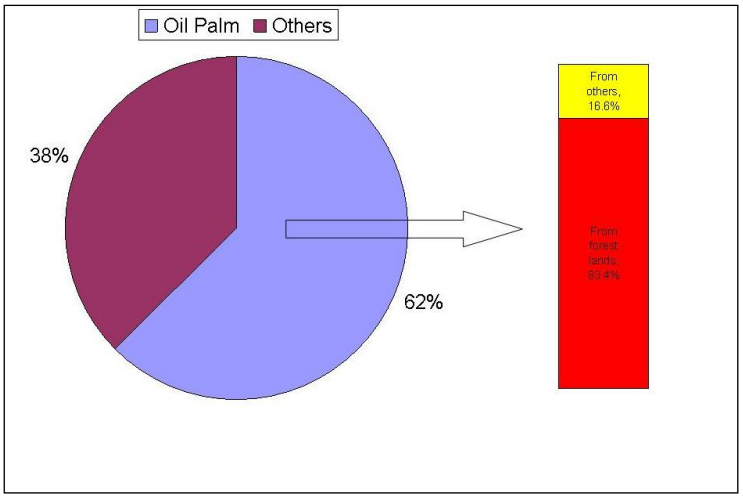
To understand the area's oil palm context, focus group discussions and interviews with key informants were conducted. The latter included community representatives, community leaders, company representatives, government agency representatives, experts (scientists) and NGO workers. Non-spatial secondary data were collected to support the analysis on the area's socioeconomic dynamic.

4.6 Results

The analysis thus far has shown that oil palm has become a major crop in Riau, providing employment to an increasing number of people. This confirms the often-mentioned positive contributions oil palm development makes to economic development and poverty reduction. It is important to understand the extent to which oil palm expansion is pushing back the forest frontier, however.

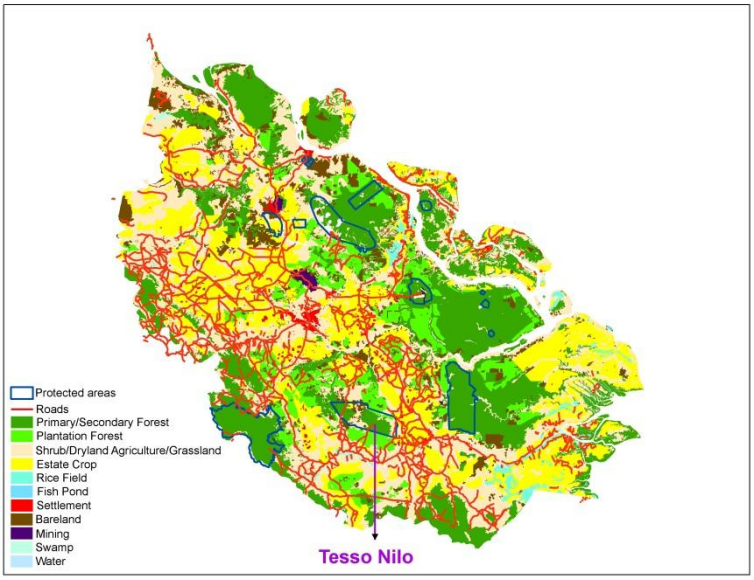
Analysis of data from various government sources and our own calculations shows that, although not all oil palm expansion has entailed the replacement of forestland, the process has generated substantial land use change in the province. It is estimated that 56% of oil palm expansion from 1990 to 2005 in Indonesia replaced forest areas (Koh and Wilcove, 2008), and this figure is higher in Riau province. Forestland released for oil palm plantation amounted to around 1.6 million ha by 2010 (Dinas Kehutanan Propinsi Riau, 2010). This translates into more than 80% of the total oil palm plantation area (Figure 4.6) and 44% of the total forest loss in Riau province in 1982-2010 (Ministry of Forestry, 2011; WWF Indonesia, 2006).

Figure 4.6 Share of forest area released for oil palm plantation and its share in the oil palm area in Indonesia up to 2010



Source: Dinas Kehutanan Propinsi Riau (2010); Dinas Perkebunan Provinsi Riau (2010); authors' calculation.

Figure 4.7 Land cover map of Riau province in 2010, protected area map and road network map



Source: BKSDA Propinsi Riau (2010); Ministry of Forestry (2005a; 2005b; 2005c).

In addition, Koh and Wilcove (2008) report that 44% of oil palm plantation replaced croplands in Indonesia in 1990-2005. Recently, Riau province has also seen the conversion of small-scale cropland areas into oil palm plantations, with farmers turning rice fields over to oil palm, given the high profits from oil palm compared with rice production. Costs of inputs in rice production are high, whereas farm-gate prices are low, often less than the former. From 2002 to 2009, in total around 15% of small-scale rice fields were converted into other uses, mainly small-scale oil palm plantations (40%), as illustrated Table 4.7 shows. Moreover, the high income obtainable from oil palm means it is easier to buy food than cultivate it.

However, rice has always been the main staple crop for more than 90% of the Indonesian population (Simatupang, 1999): at 139kg of rice per capita per year, the country is by far the world leader in terms of rice consumption (IRRI, 2012). This record, and the fact that the country's population growth is 1.02% per year, makes food self-sufficiency in rice a hot political issue (Lassa, 2005). Securing enough rice at affordable prices is critical to national security; this has long been reflected in Indonesian food policies (Burgers and Susanti, 2011; Timmer, 2004). As such, the local government in Riau is not in favour of converting rice land into oil palm cultivation. Interviews with representatives of the local government revealed that the government gives incentives to farmers who keep their rice fields for rice production, in the form of training, fertilisers and seed assistance. However, this has so far been without much success, as the push to cultivate oil palm is much greater.

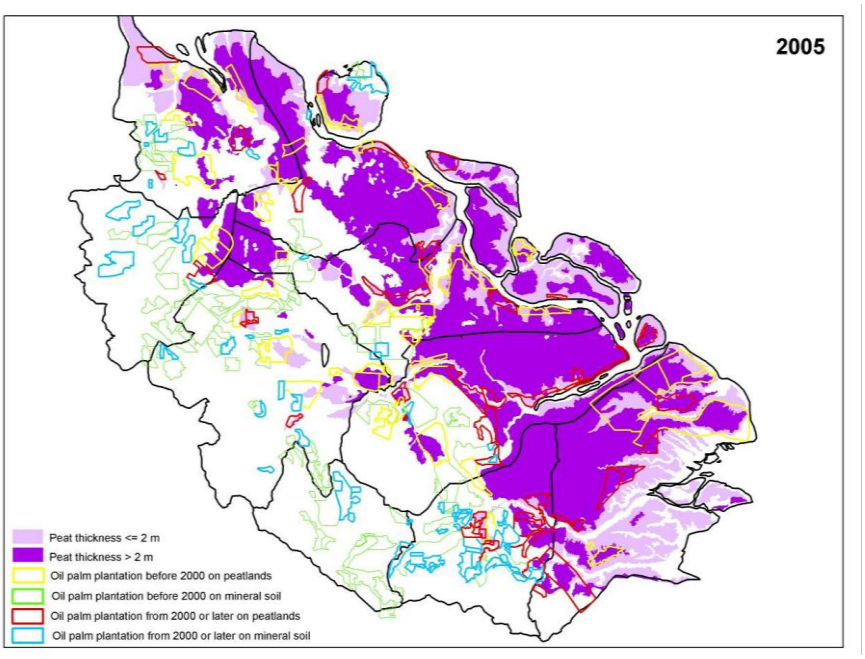
Table 4.7 Rice field conversion, 2002-2009

	Rice field conversion	Size	
		(Ha)	(%)
1	Rice field - fish pond	81.80	0.41
2	Rice field - dryland agriculture	1,901.12	9.47
3	Rice field - bare land	1,319.30	6.57
4	Rice field – mining	90.39	0.45
5	Rice field - mix estate crop	1,545.68	7.70
6	Rice field - rubber plantation	720.26	3.59
7	Rice field - coconut plantation	1,102.36	5.49
8	Rice field - oil palm plantation	8,052.76	40.12
9	Rice field – settlement	1,895.59	9.45
10	Rice field - shrub	3,360.40	16.74
	Total	20,069.66	100.00

Source: Dinas Tanaman Pangan dan Hortikultura Provinsi Riau (2010).

In addition to cropland areas, an increasing number of new oil palm plantations have been developed on peatlands. In 2000-2005, around 60% of new licenses for oil palm plantations involved peatlands (see Figure 4.8).

Figure 4.8 Distribution of oil palm plantations in Riau province, 2005



Source: Center for Soil and Agroclimate Research (1990); Ministry of Forestry (2005a); authors' analysis.

The conversion to oil palm of peatlands in particular has received increased global attention from international environmental NGOs (in particular the Worldwide Fund for Nature, WWF), which have joined hands with several multinational buyers of palm oil (such as Unilever) to develop sustainability criteria for more sustainable oil palm production, most notably the Roundtable on Sustainable Palm Oil (RSPO) criteria (Schouten and Glasbergen, 2011), especially to meet markets in the EU and US. So far, the area under oil palm plantation in Indonesia with RSPO certification covers about 1,148,134 ha, or around 14% of the total oil palm plantation area in the country (Perkebunan Nusantara VIII, 2012).

4.7 Road development

To stimulate resource-led development in Riau, infrastructural development has had to keep pace with resource extraction and the development of oil palm. Road infrastructure was considered to be very poor in the 1980s, but in the past three decades more and more roads have been established, to support the transport of bulky and heavy goods, including logs and oil palm fresh bunch fruits (Hill, 1991).

Table 4.8 Road density in Riau province, 1984-2009

	1984	**2009**
Population	2,428,302*	5,306,533
Road length (km)	1,287	23,725
Km/1,000 population	0.53	4.47
Km/1,000km^2	13.60	267.56

Note: *Calculated from Hill (1991).

Source: Badan Pusat Statistik Propinsi Riau (2011); Hill (1991); authors' calculation.

This ever-intensifying road network has connected many remote areas and triggered the development of new agricultural lands and spontaneous settlement along the roads. Access to the remaining forest areas has become increasingly easy, and distance and travel time have decreased. Figure 4.7 shows that most land in Riau province is occupied. With easier access, what were once rather remote forest areas are becoming target areas for spontaneous encroachment absorbing an increasing number of people who want to establish their own small-scale oil palm plantations or develop food cropping areas in search of survival (Derkzen, 2011; Hamzirwan and Aziz, 2011; Heijman, 2010). As one of the areas targeted for this purpose is Tesso Nilo National Park, conflicts between human beings and wildlife are also on the increase (Susanti and Burgers, 2012).

4.8 Oil palm-induced population dynamics

A study by the World Agroforestry Centre, Bogor, reveals that forest-related labour (logging, non-timber forest product collection) can support up to five people per km2, while a small-scale oil palm plantation is able to absorb 40-60 people per km2 (van Noordwijk, 2001). The development of new oil palm plantations means new employment opportunities, especially when the population increases. This fact, in combination with high earning potential, supportive road infrastructure and good markets, is leading to the influx of ever-increasing numbers of migrants into Riau province. In 2010, population growth in the province was at 4.46% (Badan Pusat Statistik Propinsi Riau, 2011), much higher than national population growth, which is at around 1.3% (Badan Pusat Statistik, 2011b). It is estimated that migrants comprise around 24% of the total population. Of this group, about 67% were involved in the so-called transmigration programmes (Badan Pusat Statistik Propinsi Riau, 2011).

Although there is no big difference in population between districts, several districts, such as the city of Pekanbaru in Kampar and Inderagiri Hilir, have quite a high population concentration compared with other districts in the province. In 2010, these districts took up 16.3%, 12.4% and 12.0% of the total population of the province, respectively. Kepulauan Meranti, established in 2008, contains only 3.2% of the population (Badan Pusat Statistik Propinsi Riau, 2011). However, migrants are to be found almost everywhere. Many come from Java and use the social networks established by settled transmigrants. Moreover, many of these migrants are well off, able to buy out local people from their land to establish oil palm plantations. Livelihood research in Riau province points to an increasing number of migrants occupying forest frontier areas, indicating that most of the suitable land has already been occupied (Sondereger and Lanting, 2011). National parks are one type of area on which migrants are encroaching. For instance, small-scale farmers are establishing oil palm

plantations in Tesso Nilo National Park (Derkzen, 2011; Heijman, 2010). In 2010, WWF Indonesia estimated that 28,000 ha of the 83,000 ha in the national park had been converted into small-scale oil palm plantations and settlements. Of those taking part in this, 96% appear to be migrants; only 60 local households have been involved (WWF Indonesia, 2010).

Box 4.3 The transmigration programme in Riau province

The transmigration programme has a long history, starting in the Dutch colonial era and then continuing after independence, in particular during 1968-1988. During this period, transmigration programmes aimed to fulfil the demand for labour in low-populated areas (outside Java island) to enable development there (Jelsma, 2009). Most importantly, it is also aimed at promoting national integration and security (Hoshour, 1997).

The first transmigration programme in Riau province was in the early 20th century and was associated with mining activities. Forestry development in the early 1970s in the form of forest concessions and large-scale forestry industry brought another large influx of migrants into the province. The establishment of industrial forest plantations and the pulp and paper industry in the 1980s saw yet another influx of migrants to satisfy the demand for labour (Sumardjani, 2005). During the same period, the special transmigration programme for oil palm plantation (PIR Khusus) began (Jelsma, 2009). When forest business decreased as a result of illegal logging and forest encroachment, oil palm became the real livelihood alternative and spread rapidly. This development triggered another influx of migrants, mostly spontaneous, seeking better employment and opportunities for a better livelihood (Hoshour, 1997).

The next phase of our research will attempt to estimate the number of spontaneous migrants and others entering the final frontier areas in Riau province, not only in national parks but also in protected forest areas in the peatlands. Remote sensing pictures combined with on-the-ground verification of these will hopefully help us to explain the extent of this hidden indirect effect and of the forest conversion process undertaken by small-scale oil palm producers.

5 Discussion and conclusion

This paper has shown that global developments in the prices of fossil fuels in general, and price fluctuations in particular, have triggered the search for alternative fuels, especially in the transport sector. Agreements by most countries in the world to reduce GHG emissions under the Kyoto Protocol have also led to a growing demand for renewable sources of fuel, most notably biofuels. The oil palm is increasingly being seen as the most promising agricultural crop for this purpose. Of all biofuel crops, it has the highest yield per ha and can be produced at the lowest costs.

Indonesia has recently become the world leader in palm oil production. Triggered by ever-increasing global demand for palm oil, both for food and for fuel, the country is able to export about 85% of its palm oil, contributing substantially to its foreign exchange earnings. These developments, together with the high targets set by the international community to reduce GHG emissions (up to a 20% reduction in 2020 compared with the BAU scenario), as well as the ambitious 26% reduction in GHG emissions committed to by the Indonesian government, mean biofuel scenarios in Indonesia based on palm oil are seeing a projected increases. Meanwhile, to secure domestic supplies of palm oil, the government has imposed taxes when export prices go beyond $700 per ton.

Oil palm cultivation has various important benefits. Oil palm is an important driver of economic development and growth in Indonesia, creating employment and generating incomes for many (mostly) rural dwellers. However, this success also creates difficulties, as expansion of cultivation may threaten food cropping land and hence food security, such is the case in Riau province, where food cropping areas are increasingly being converted into (small-scale) oil palm plantations. In addition, the environmental sustainability of the process is often questioned. Studies on Indonesia seem to point to the fact that oil palm plantation contributes only modestly to deforestation, although these analyses seem to contradict a growing body of literature pointing to its negative environmental consequences.

The main explanation might be the fact that oil palm is concentrated in only a few islands, of which Sumatra is the most important producer. Including islands where no oil palm is cultivated in the equation of oil palm-induced deforestation does not seem to be logical, as this would show lower figures for oil palm-induced deforestation, especially if other forms are included. Meanwhile, our research on Riau province in Sumatra shows that oil palm-induced deforestation is significant. In only three decades, intensive land use change in Riau has reduced primary and secondary forest cover to only 36%, with forestlands released for oil palm plantation amounting to around 1.6 million ha by 2010. This translates into more than 80% of the total oil palm plantation area and 44% of the total forest loss in Riau province in 1982-2010.

In addition, in the past 20 years, oil palm cropping has expanded tremendously and led to further dramatic changes in Riau province. While in its early stage of development, the industry needed support from transmigration programmes to fulfil labour requirements; nowadays, large numbers of migrants are moving into Riau spontaneously. Javanese migrants in particular make use of social networks established when the first transmigrants arrived in Riau, but migrants from other parts of Sumatra have also moved in to capitalise on the opportunities inherent in oil palm cultivation. Now that the road infrastructure, markets and the ability to cultivate oil palm at an individual level have improved, oil palm is a very interesting and highly profitable crop for small-scale farmers. Anyone who is able to access land can establish a (small-scale) oil palm plantation. However, our remote sensing data show that most arable land in Riau is already occupied. This points to another, second wave of oil palm-induced deforestation, this time caused by migrants and small-scale farmers encroaching on the remaining forest area, which is quite often in protected areas. In Tesso Nilo National

Park, for example, (illegal) encroachment has led to the conversion of 28,000 ha (or around 25%) into small-scale oil palm plantations.

It is clear that oil palm has the potential to play a prominent role in the resource-led development process of Indonesia, in particularly through its ability to incorporate large numbers of poor, rural people. However, this success is also its danger. Our analysis shows that unused land is becoming scarce and rice fields and remaining (protected) forest areas are increasingly being converted (legally and illegally) into oil palm plantations. Converting rice fields into oil palm plantations is a worrying development for the local government, as securing enough rice at affordable prices is critical to national security, given that huge amounts of people live in the cities. Incentives from the local government to stimulate the continuous cultivation of rice seem to have had little effect, as small-scale oil palm producers find it easier to buy rice from the income they derive from palm oil. Meanwhile, whereas oil palm expansion was initially a large-scale process, it is increasingly becoming a process guided by individuals, mainly migrants, who own small-scale oil palm plantations. Recently, local people have also begun to take part in the oil palm boom.

Oil palm cultivation and palm oil production can do a great deal for people and in terms of profit, but its effect on the planet (its environmental sustainability) remains questionable. In future research, we will further analyse the indirect effects of oil palm expansion in Riau as an example of the magnitude of ILUC in Indonesia.

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